# Teeth

## Enamel

INTRODUCTION : Teeth are composed of three mineralized tissues enamel, dentin and cementum surrounding an inner core of loose connective tissue, the dental pulp. Enamel is ectodermal in origin. Enamel covers the crown of tooth. It is thickest over the cusps and incisal edges and thinnest at the cervical margin over the cusps of the unworn permanent teeth it is 2.5 mm thick, on deciduous 1.3 mm and on lateral surfaces up to 1.3 mm.

Enamel is the hardest biological tissue and while highly mineralized withstand both shearing and impact forces is brittle, it has a high modulus of elasticity and this, together with the flexible support of the underlying dentine, minimizes the possibility of fracture. Enamel has a high specific gravity (~3)

The properties of enamel vary at different regions within the tissue. Surface enamel is harder, denser and less porous than the subsurface enamel. Hardness and density also decrease from the surface towards the interior and from the cuspal / incisal tip towards the interior and, from the

cuspal / incisal tip towards the cervical margin.

Enamel is a birefringement crystalline material, the crystals refracting light differently in different directions. Translucency of enamel increases with age and some of the colour of the underlying dentine is then transmitted, resulting in a more yellowish appearance. The tissue has an average refractive index of 1·62.

CHEMICAL PROPERTIES

Calcium hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$ is the principle mineral content of enamel, comprising about 88-90% of the tissue by volume, which corresponds to about 90-95% by weight, the remainder being the organic material and water.

Hydroxyapatite is present as a crystalline about 70nm in width and 25 nm thick and of great length.
Water constitutes 2% by weight of enamel, corresponding to 5-10% by volume. The presence of water is related to porosity of the tissue.
Mature enamel contains only 1-2% of organic matrix. A wide variety of organic molecules ranging from free amino acid to large unique protein complexes.

These proteins are the amelogenins and non-amelogenins. The concentration of protein is highest in enamel tufts at the dentino-

enamel junction.

## STRUCTURAL AND ORGANISATIONAL FEATURES OF ENAMEL :

## Enamel Prisms

The basic structural unit of enamel is the enamel prism or rod consisting of several million hydroxyapatite crystallites packed into a thin rod 5-6 μm in diameter and upto 2.5 mm in length. Prisms run through the enamel dentin junction to the surface

In cross section the shape of enamel prism approximates to one of the three main patterns. All the three patterns are present in humans but pattern III, the key hole pattern predominates. The key hole pattern III shows clear head and tail region, the tail of one prism lying between the heads of the adjacent prism and pointing cervically.

## Aprismatic Enamel

The outer 20-100 μm of enamel of newly erupted deciduous teeth and the outer 20-70 μm of newly erupted permanent teeth is aprismatic. Here the enamel crystals are aligned at right angles to the surface and parallel to each other. This surface is highly mineralized as there is absence of prism boundaries

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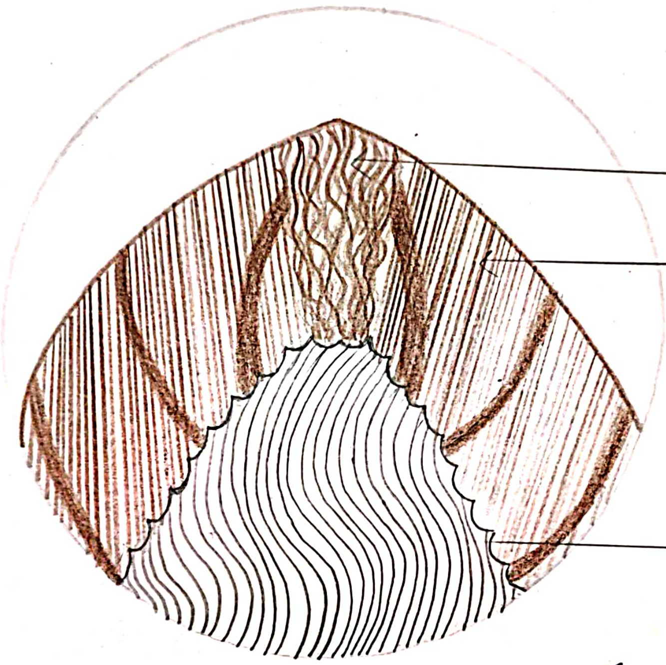
Aprismatic enamel occurs as a result of the absence of Tome's process on the ameloblasts in the final stages of enamel deposition.

# Gnarled Enamel



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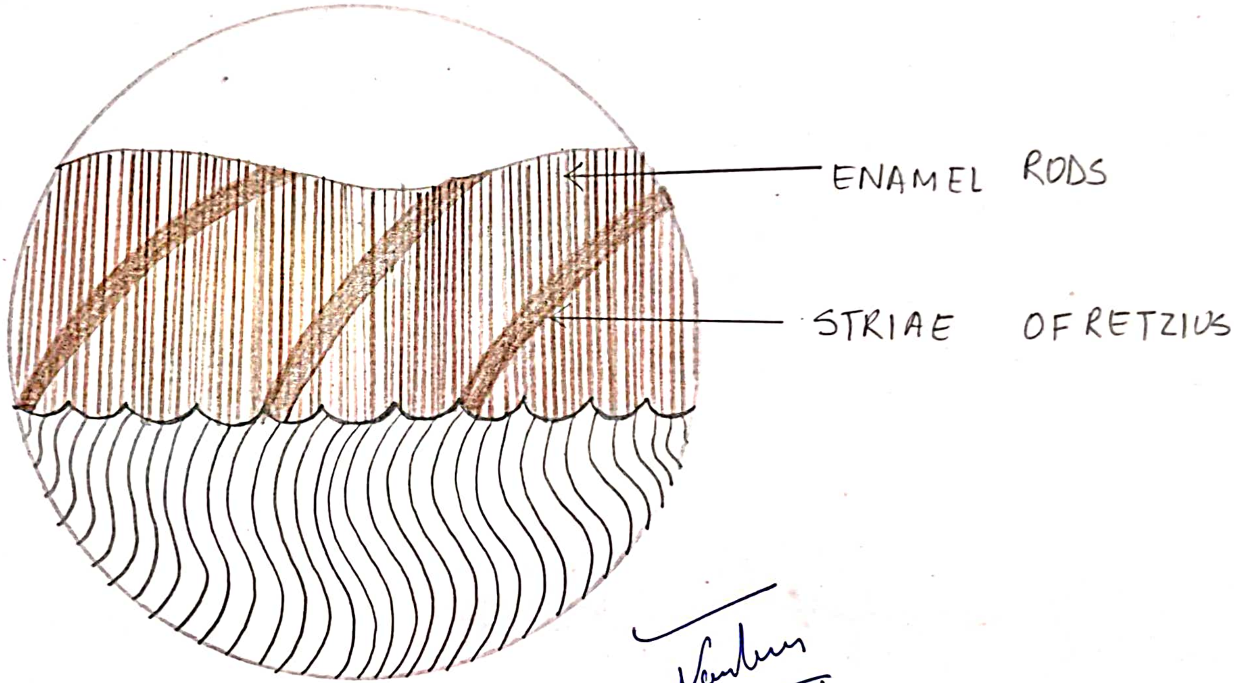
# Gnarled Enamel

Enamel rods follow a wavy course as they extend from dentino enamel junction towards the outer surface. In the region of cusp and incisal edges the arrangement of enamel rods is more complicated.

The rods are irregular and intertwine with each other in this region specially DEJ.

This arrangement creates an optical appearance referred to as Gnarled enamel. This particular arrangement of rods in cuspal and incisal region makes Enamel stronger to withstand masticatory forces or masticatory stress

# Striae Of Retzius



# Striae Of Retzius

Enamel is formed incrementally, periods of activity alternating with periods of quiescence. This result in structural markings known as incremental lines. There are two types : short period (cross striations) and long period (enamel striae)

When sections of enamel cut along the longitudinal axis of the crown are viewed, structural lines are seen to run obliquely across the prisms from the enamel dentin junction extending from DEJ to the surface. These represent incremental lines and known as enamel striae (of Retzius)

In horizontal sections of the crown, the enamel striae run circumferentially like the rings of a tree.

These structural lines appear as brownish bands in ground section. In the region of incisal edge and cusps they surround the dentin while in cervical region they are seen as oblique lines extending from DEJ towards the outer surface deviating in an occlusal direction.

The line is hypocalcified and reflects variation in structure and mineralization.

# Neonatal Line

Is the prominent line that separates the enamel that is formed before birth (prenatal enamel) and after birth (post natal enamel).

In human teeth, there are 7-10 cross striations between adjacent striae in any one individual. The striae are therefore formed at about weekly intervals. As the average distance between the two cross striations is about 4 $\mu m$, enamel striae in the middle portion of enamel are about 25-35 $\mu m$ apart.

Over the lateral enamel, enamel striae reach the surface in a series of fine grooves running circumferentially around the crown. These features are known as the perikymata grooves and are separated by ridges, the perikymata ridges.

# Dentino Enamel Junction

The junction between enamel and dentin is established as these two hard tissues begin to form and is seen as a scalloped profile in cross-section.

The scanning electron microscope reveals the junction to be a series of ridges rather than spikes which arrangement probably increases the the adherence between dentin and enamel, in this regard it is worth noting that the ridging is most pronounced in coronal dentin, where occlusal stresses are the greatest.

The shape and nature of the junction prevent shearing of enamel during function.

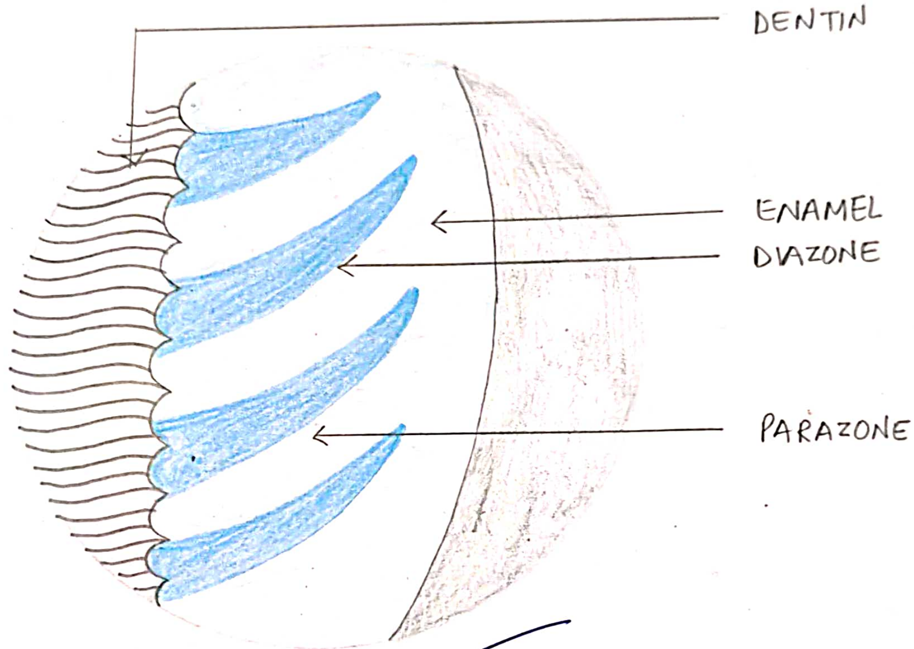
## Applied :

When cavities are prepared, knowledge of the microanatomy of enamel, particularly in terms of prism orientation, is essential to conserve as much of possible of the original strength of the tissue. Cutting cavities into enamel with rotatory instrument will inevitably lead to subsurface cracking. Fortunately, some of the adhesive materials are capable of reinforcing this weakened substrate.

# Enamel Pearls

These are small isolated spheres of enamel that are occasionally found on the root, generally towards the cervical margin. The enamel is prismatic with the prisms following an irregular course. They are particularly common in the root bifurcation region where they may predispose to plaque accretion following gingival recession.

# Hunter Schreger Bands



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# Hunter Schreger Bands

They are alternate dark and light bands of varying width observed in enamel than the longitudinal section is viewed in the reflected light.

These bands arise from the dentino-enamel junction and pass outward till the inner two-third of the enamel thickness.

HS bands are not seen in outer one third of enamel because the enamel rods are straight in this region. These bands are an optical phenomenon produced by changes in direction between adjacent groups of rods.

When viewed under reflected light, these prisms lined parallel to the light beam would reflect the light away from the microscope and appear as dark bands. The prism lined less parallel to the light would reflect the light through microscope and appear bright.

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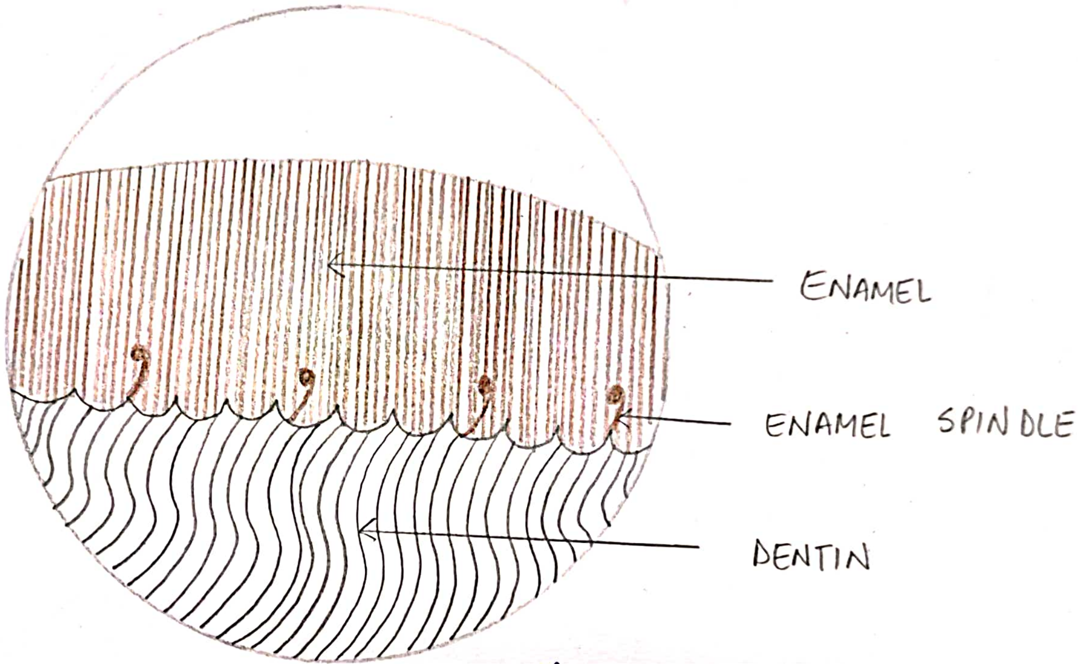
# Enamel Spindles

Enamel spindles are the odontoblastic processes crossing the dentino - enamel junction and extending to the enamel. They are not aligned with the prisms and are thought to be the result of some odontoblast processes that, during the early stages of enamel development, insinuated themselves between the ameloblasts.

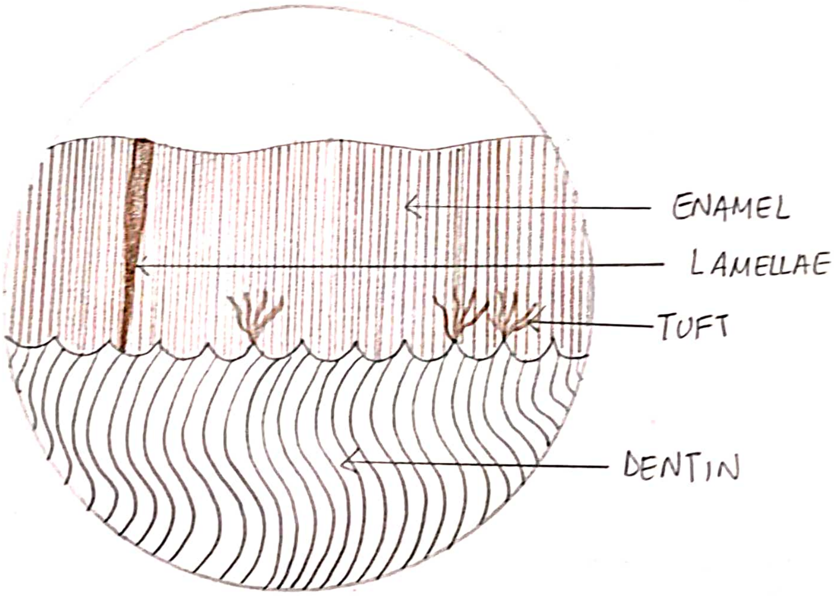
Narrow (upto 8 μm in diameter), round, sometimes club shaped tubules - the enamel spindles - extend upto 25 μm into the enamel.

They appear dark in ground section under transmitted light because the organic content of spindle is lost and is replaced by air. Enamel spindles are seen more in the region of cusp tip. They are best seen in longitudinal section of enamel.

# Enamel Spindles.



# Enamel Tuft and Lamellae



# Enamel Tuft

Enamel tuft is the term given to junctional structures in the inner third of enamel that, in ground section, resemble tuft of grass. They appear to travel in same direction as the prism and, in thick sections, undulate with sheets of prism.

They are hypomineralsied and reoccur at approx at 100 μm intervals along the junction. They are best viewed in transverse section.

It has been suggested that this appearance result from protein, presumed to be residual matrix, at the prism boundaries of hypomineralized prisms.

# Enamel Lamellae & Cracks

Enamel lamellae are sheet like apparent structure faults that run through the entire thickness of enamel. They are hypocalcified and narrower, longer and less common than enamel tufts but, like tufts are best visualised in transverse sections.

In ground sections, many lamellae like structures are simply cracks produced during section preparation. This can be confirmed by demineralizing the section, when cracks will disappear but not true lamellae.

Lamellae may arise developmentally due to incomplete maturation of groups of prisms or after eruption as cracks during function.

Three types of lamellae are seen.

Type A : composed of poorly calcified enamel rods, this type is restricted to enamel.

Type B : consists of degenerated cells & may extend into dentin.

Type C : filled with organic matter derived from saliva